Investigating the morphotectonic evolution of Chiayi-Tainan area based on geomorphometry and fluvial terraces

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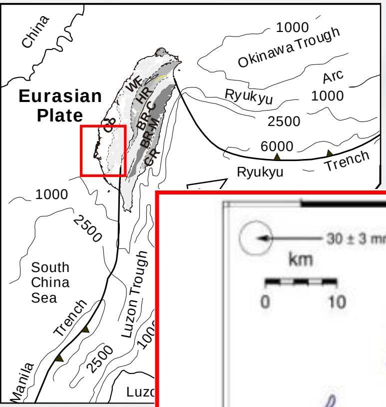
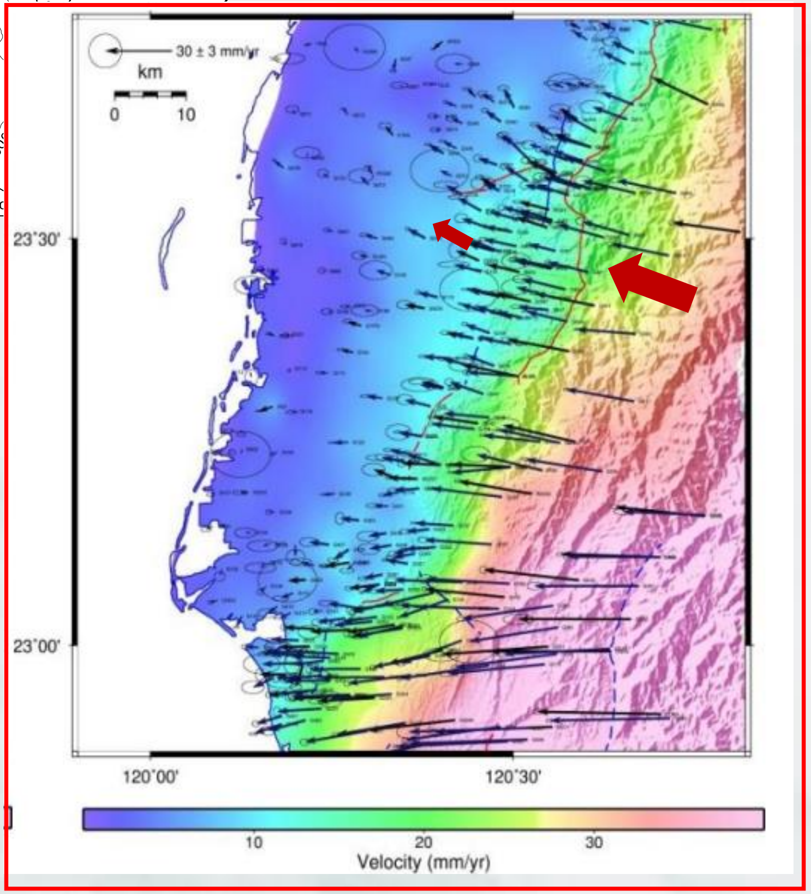
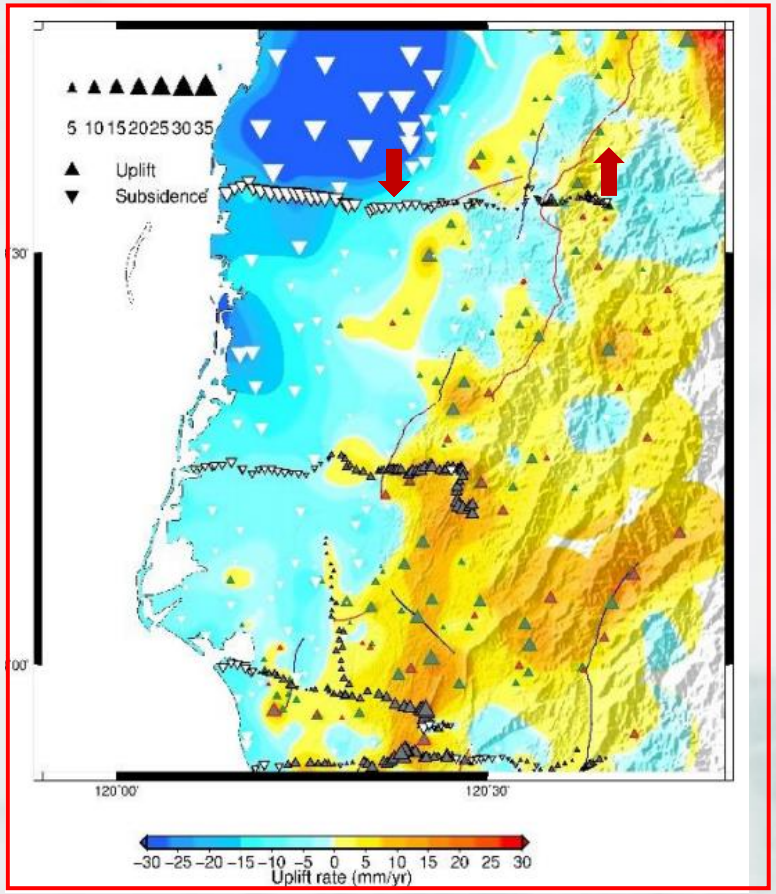
Date: 2023/03/10



2010-2017
horizontal velocity field



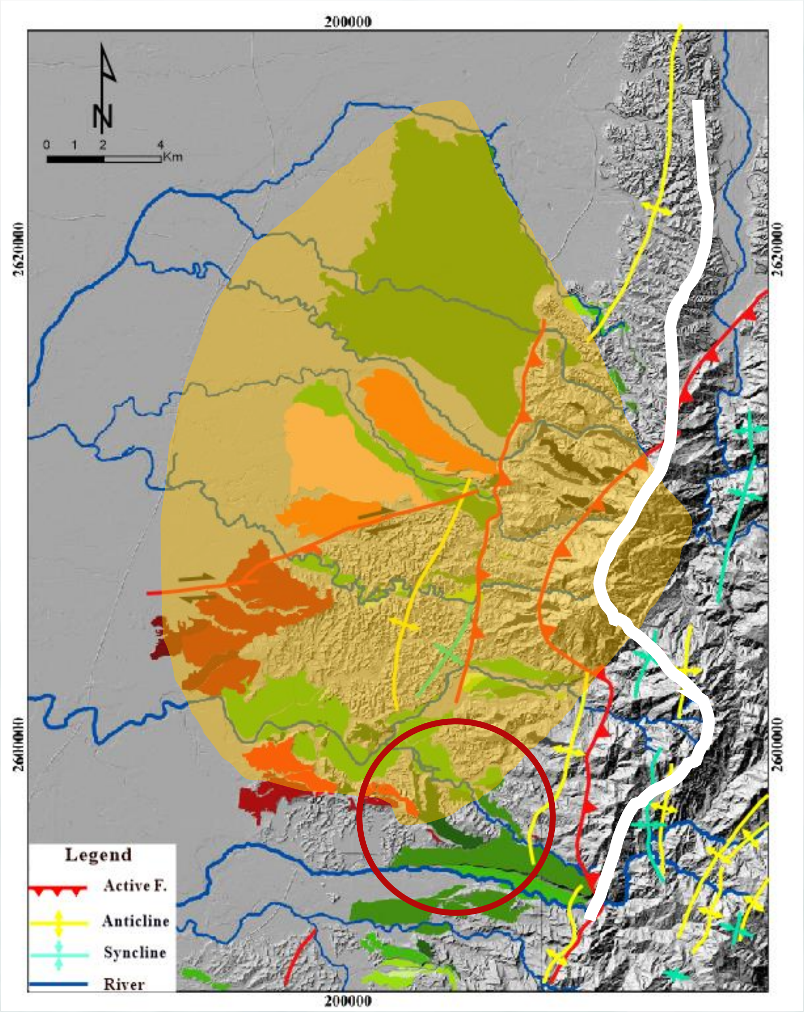
2010-2018
vertical velocity field



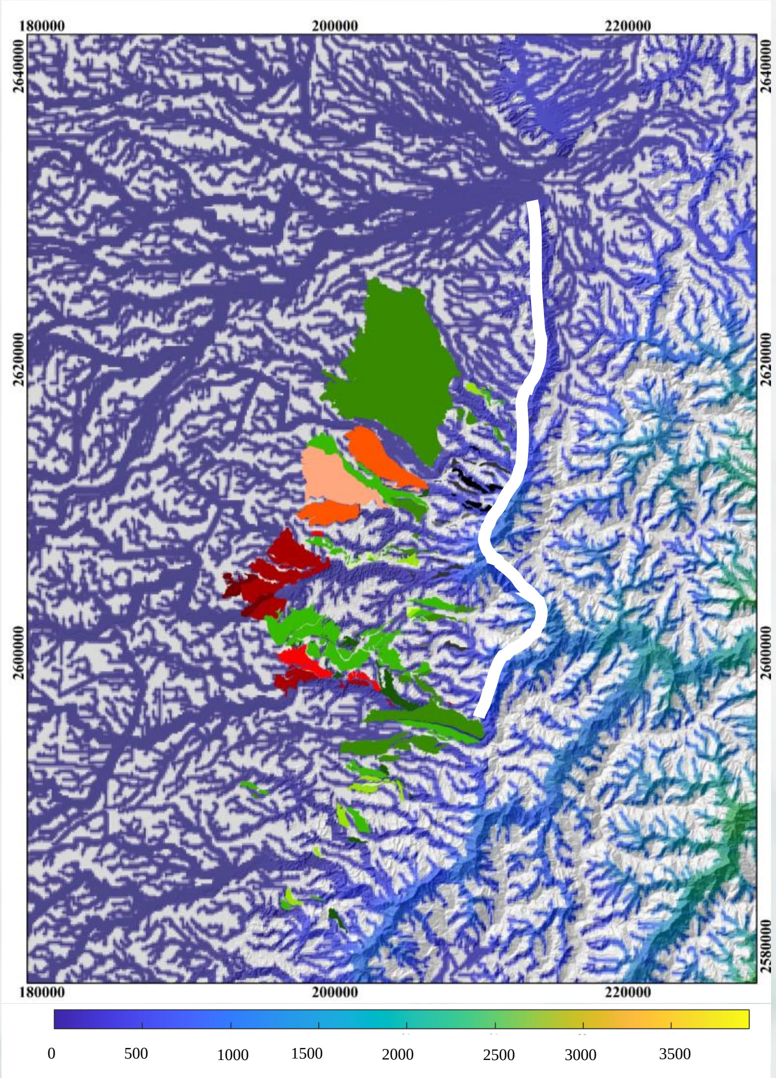
Motivation:

1. GPS observation implies the compression state exists in south-western Taiwan.

Geodetic data in south-western Taiwan (Ching et al., 2018)



(Modified after Feng, 2004)



Divide elevation(m)

Motivation:

2. There are large alluvial fan deposits, but most of the present rivers are too short.

→ River path changes

3. Abandoned surfaces exist, but there is no structure been mapped.

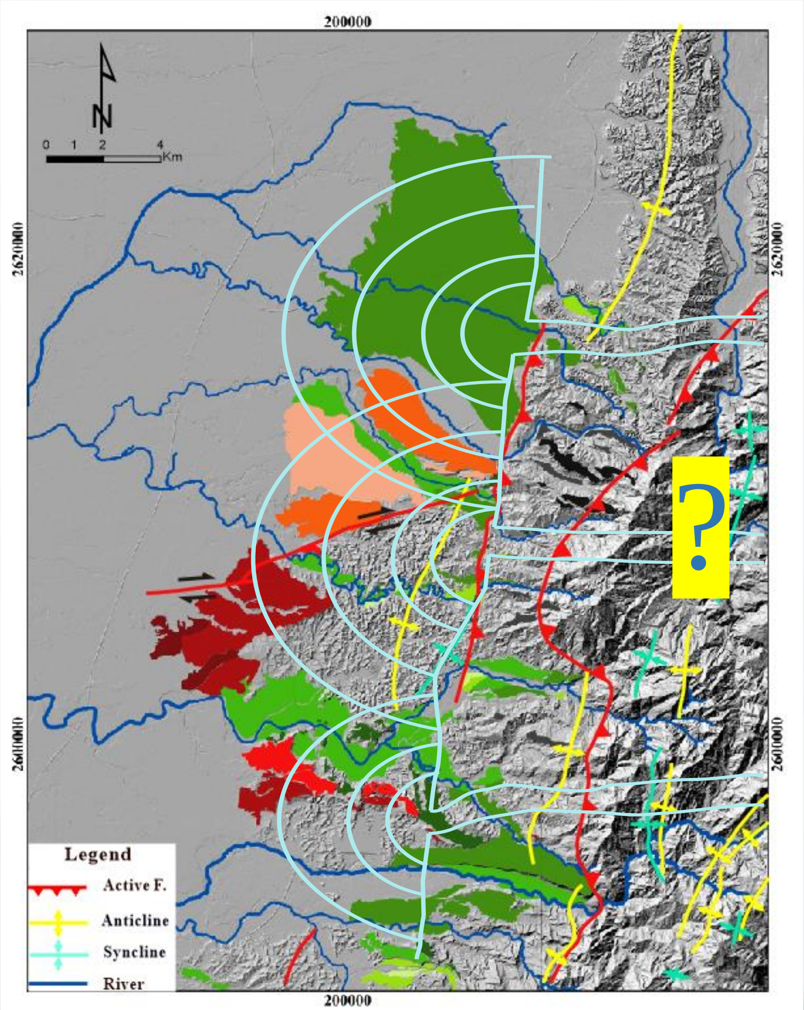
Purpose:

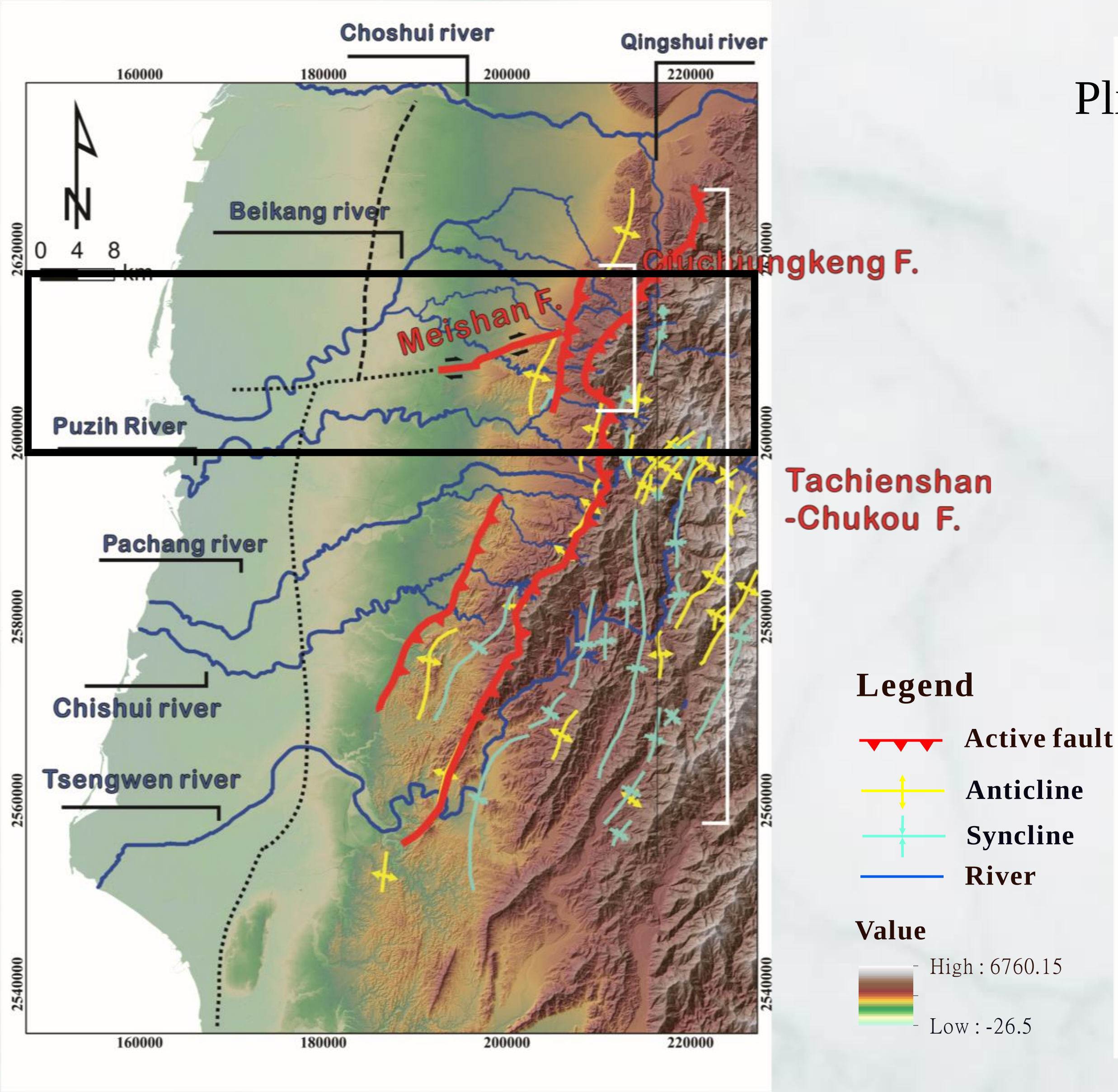
To understand how morphotectonic evolve under the result of tectonic and landscape processes.

1. Investigate the appropriate source of the big alluvial fan.
2. Analyze the reasons why the river path changes.

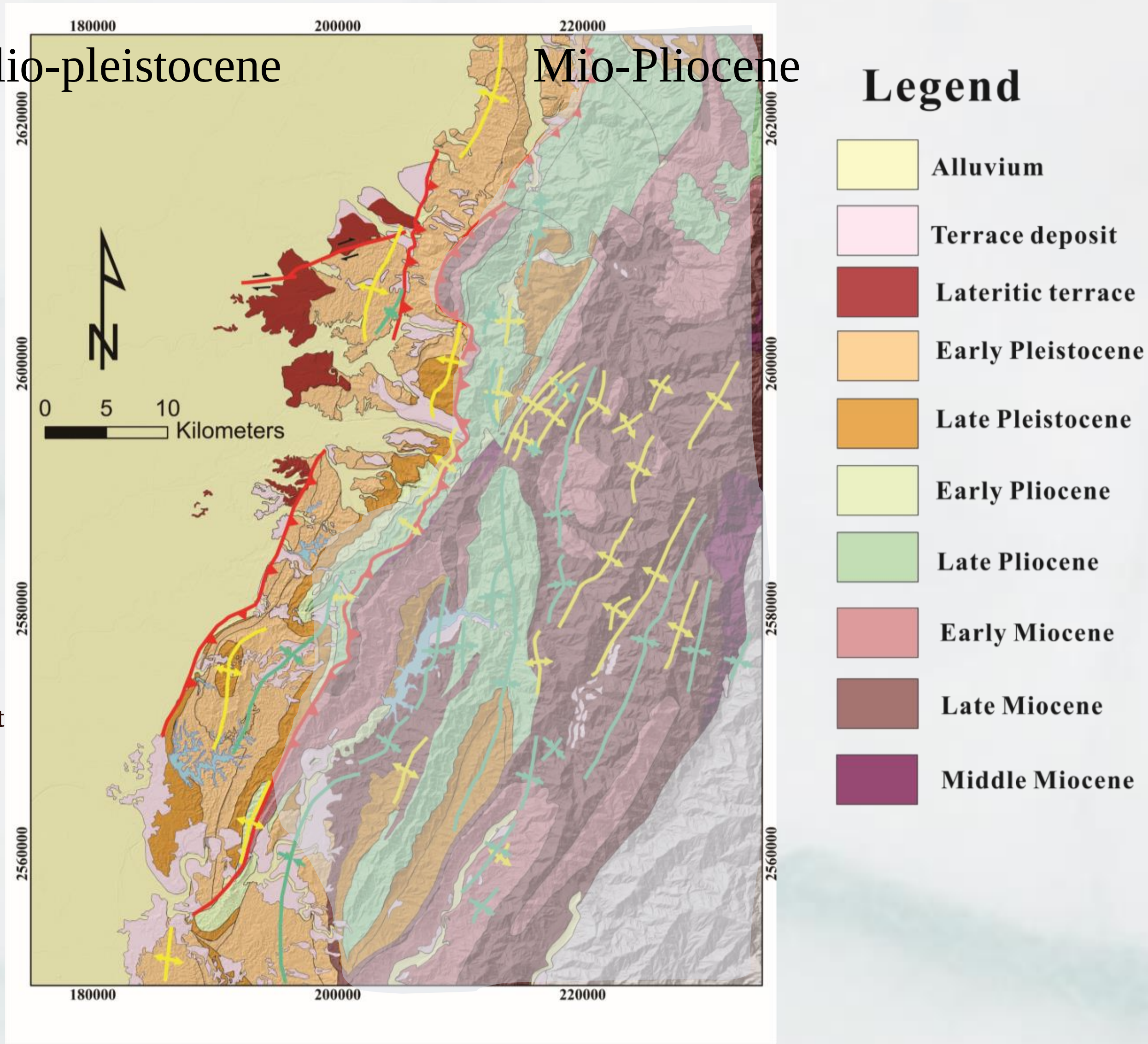
- The river is the most important driver to the landscape changes.

- We use fluvial geomorphic indices as our tools.





Topography Map



Geological Map (Modified after CPC 1/100000 geological map, 1986)

Basic concept

Fluvial systems

Factors: Climate, Structure, Lithology

↓

Slope

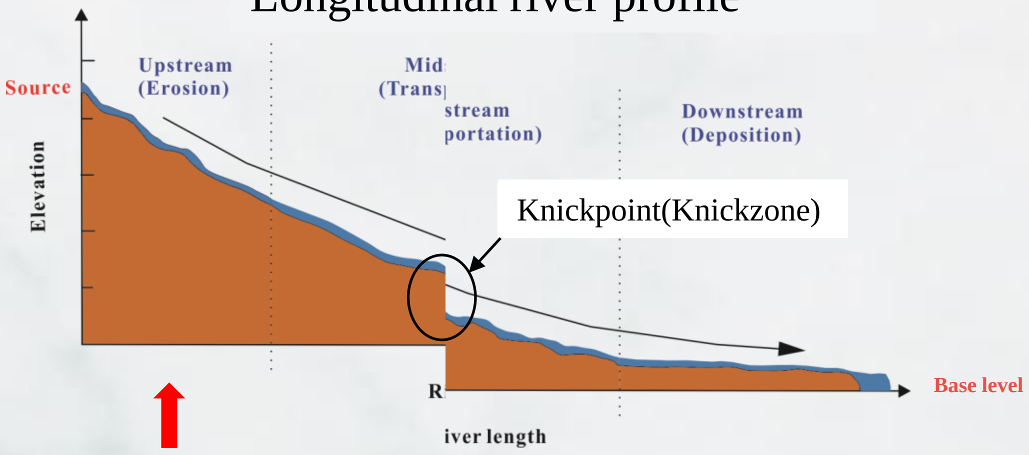
↓

Stream Power

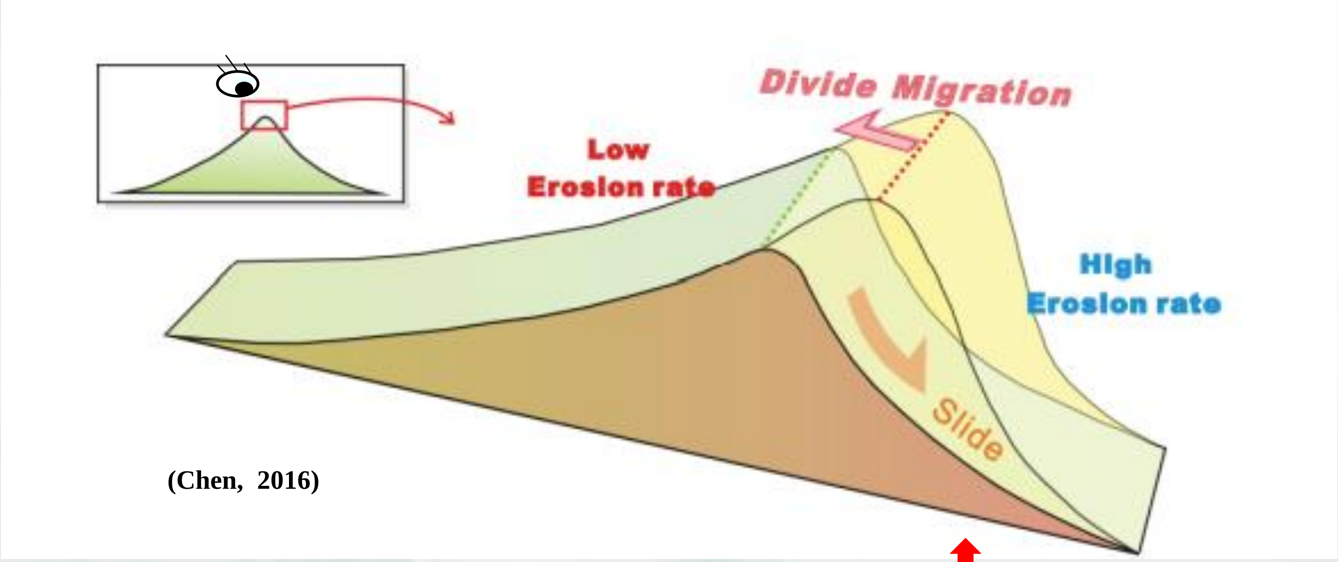
River profile — Steepness index (Ksn)

Divide migration — χ -Plot

Longitudinal river profile



https://laulima.hawaii.edu.



(Chen, 2016)

The stream power incision model
(Hack’s Law)

- $\frac{dz}{dt} = U - \boxed{kA^m \times (S)^n}$

Uplift — Erosion

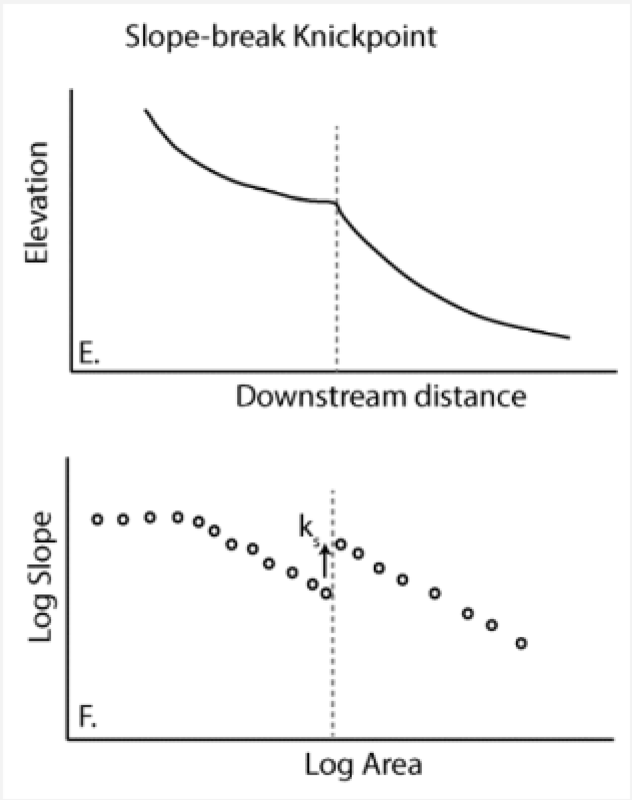
z: elevation
k: erodibility factor
A=catchment area
S= slope

- Steady state: $S = k_{sn} A^{-\theta}$, $k_{sn} = \frac{U}{k}$, $\theta = m/n$

Steepness index — Concavity index

Equilibrium : uplift = erosion

$\theta = m/n = 0.5$ (Willett et at., 2014)



χ –plot (Perron&Royden.,2012)

$$z(x) = z(xb) + \left(\frac{U}{kA_0{}^m}\right)^{\frac{1}{n}} \chi$$

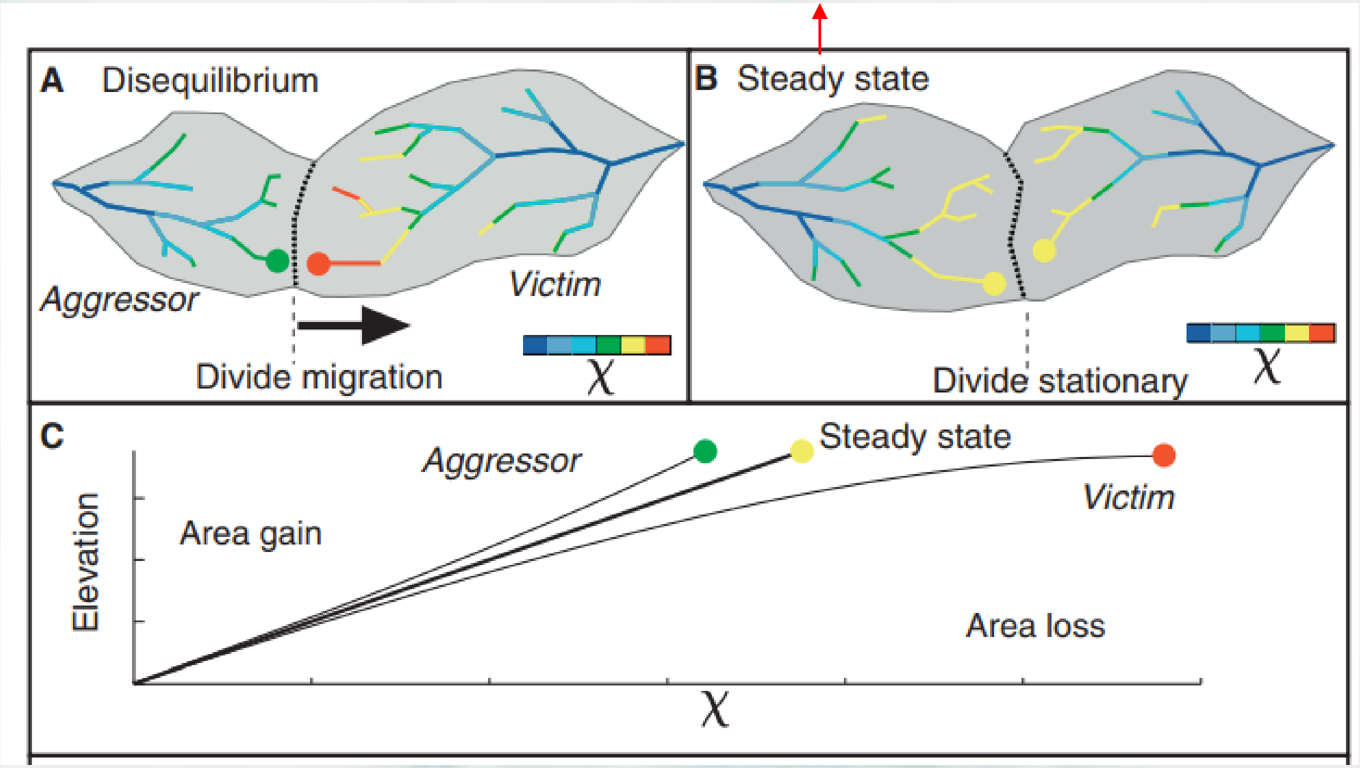
$$\boxed{\chi = \int_{x_b}^{x} \left(\frac{A_0}{A(x)}\right)^{\frac{m}{n}} dx}$$

X: head distance
X_b: outlet distance
A: catchment area
A_0: Reference drainage area

$$k_{sn} = \frac{U}{k}$$

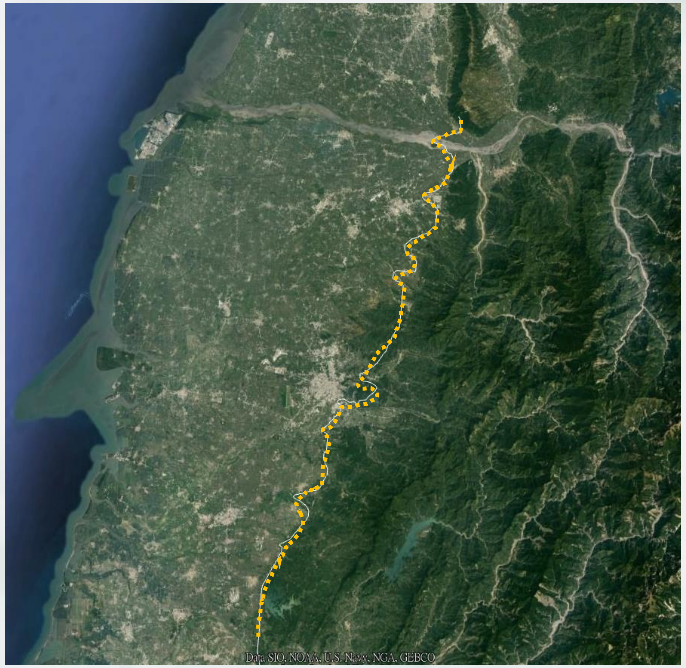
$\theta = m/n = 0.5$ (Willett et at., 2014)

Erosion = uplift



(Willett et at., 2014)

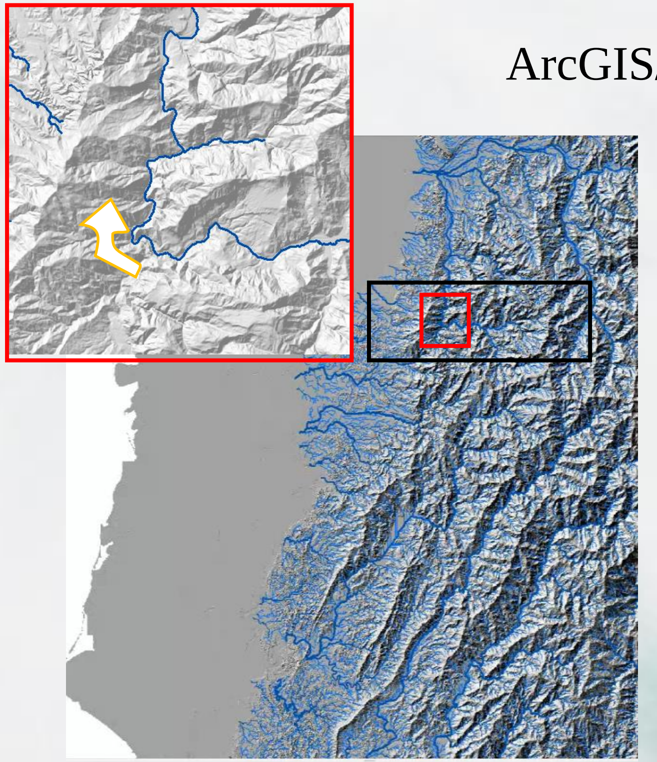
Google Earth

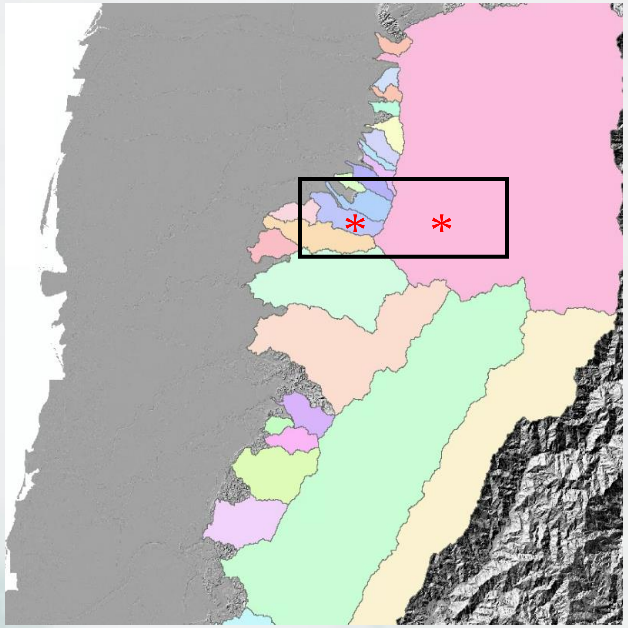


Choose bedrock river

→

ArcGIS/Matlab





Generate drainage/ Classified the catchments

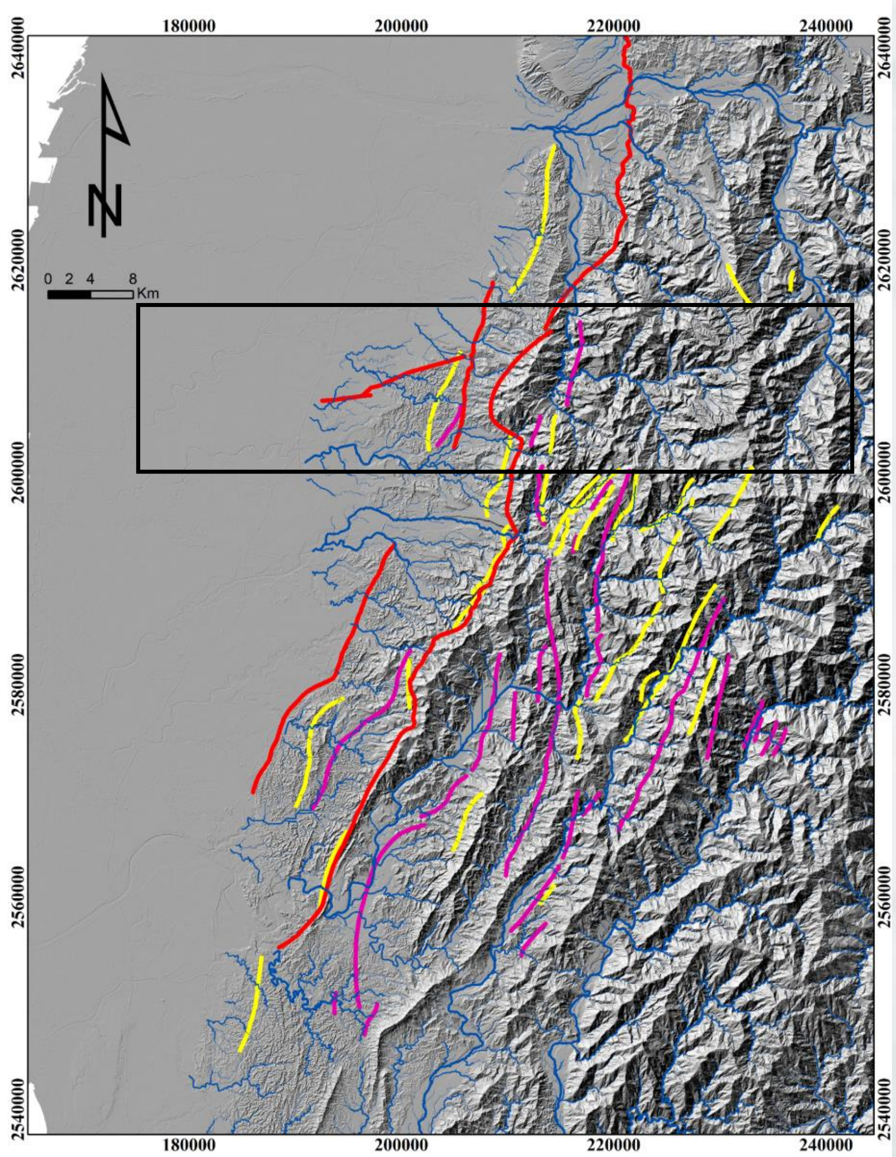
→ River profile
Knickpoints (Knickzone)

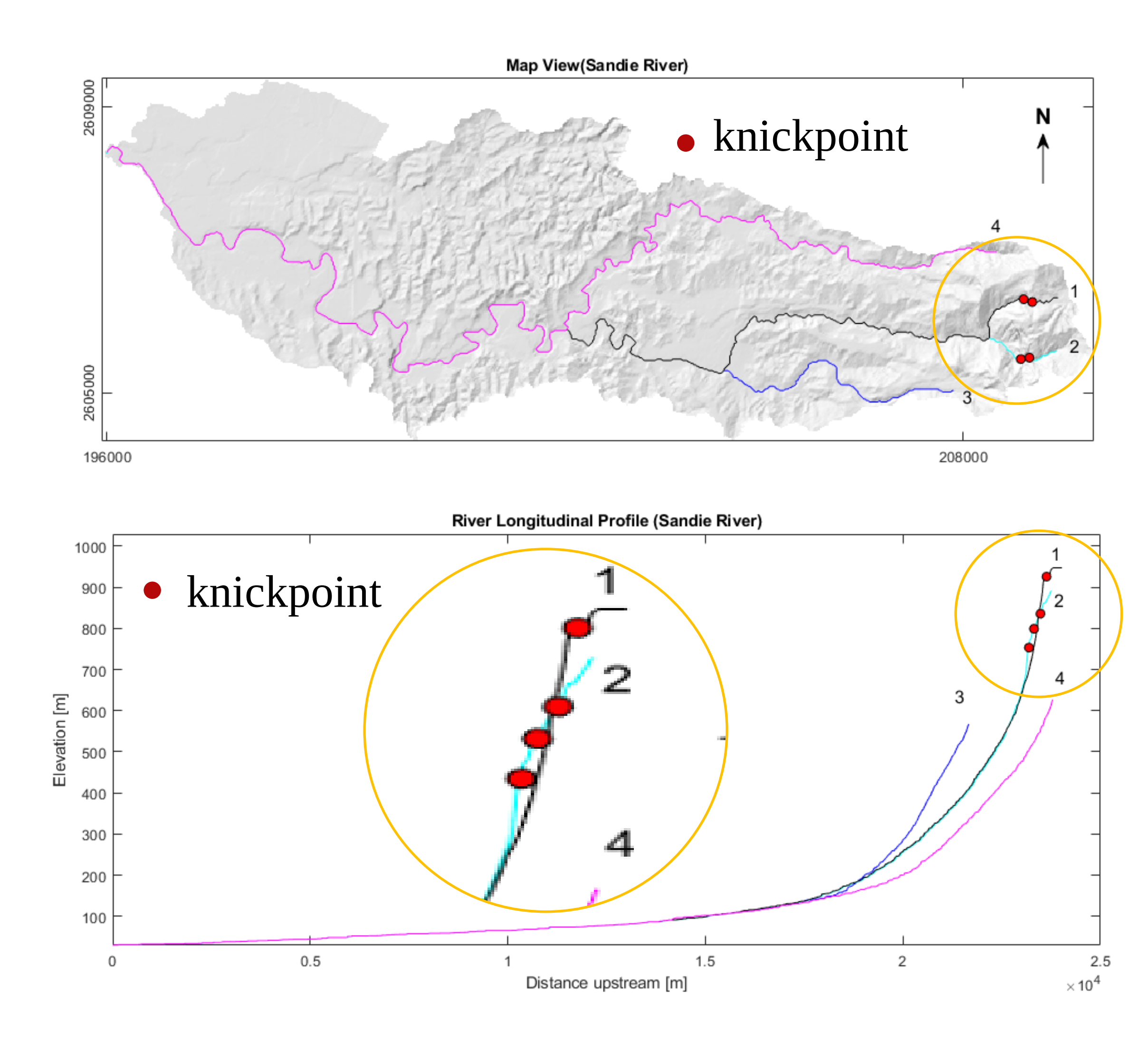
Locate anomalies

→ Chi plot and steepness → Results

Assess the dynamic of drainage networks in the past and future
Indicate the tectonic activity

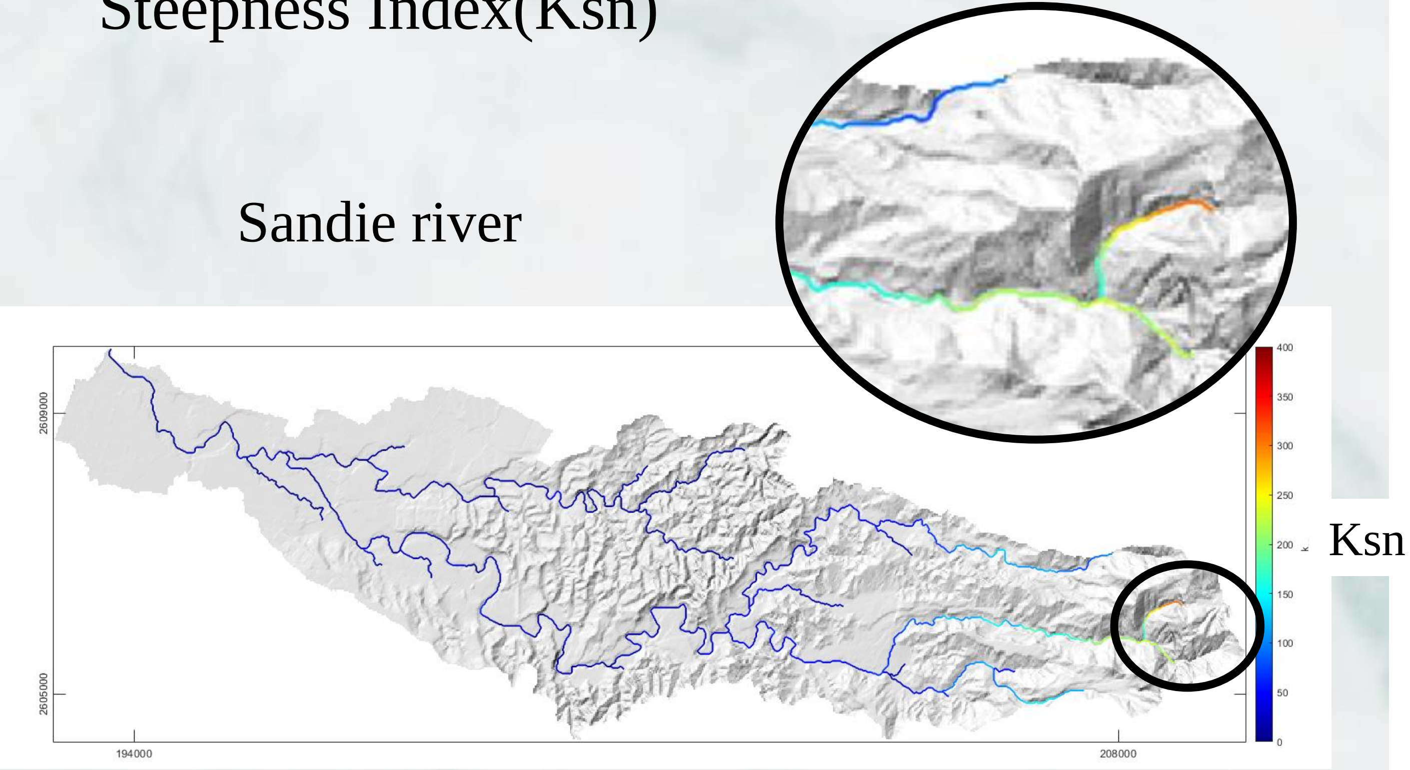
River profile



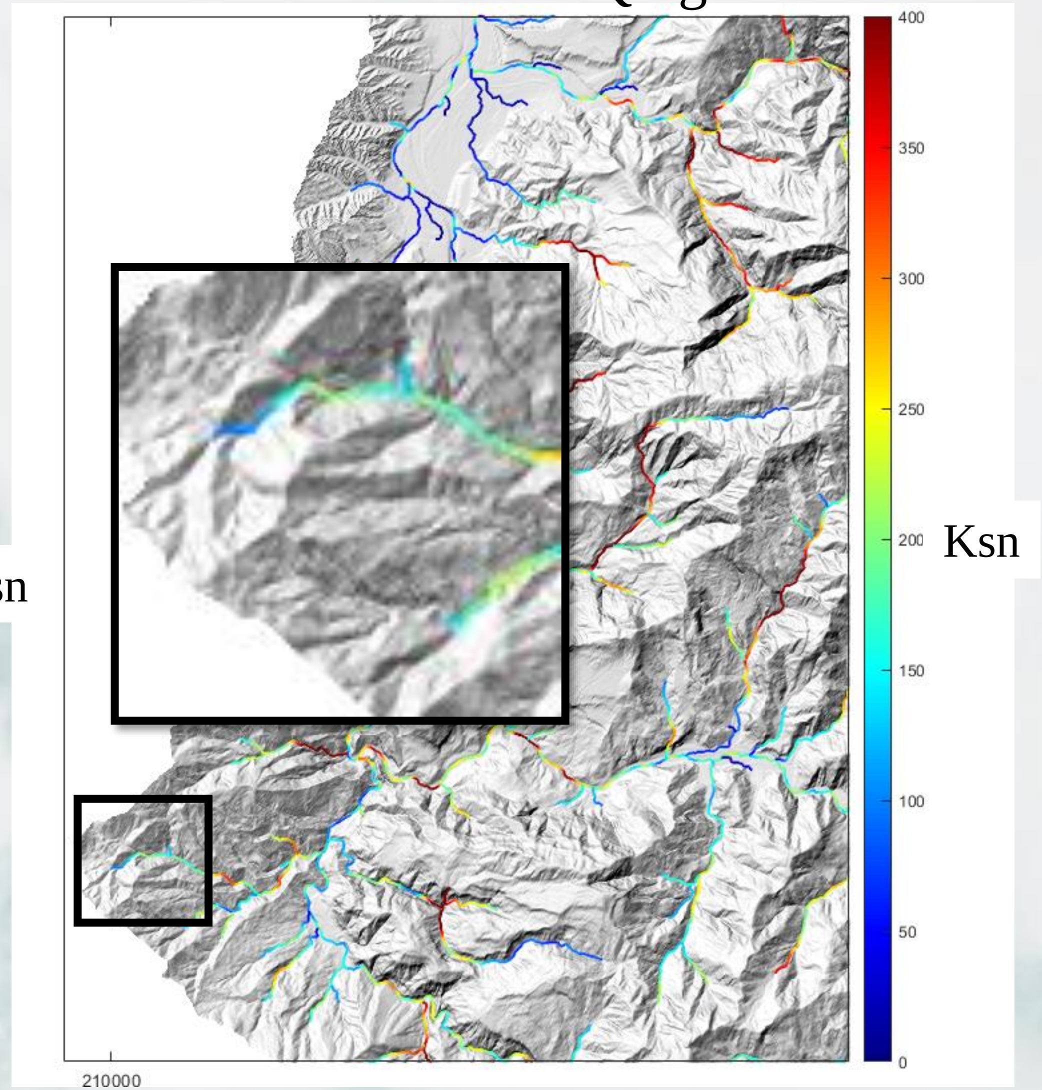


Steepness Index(Ksn)

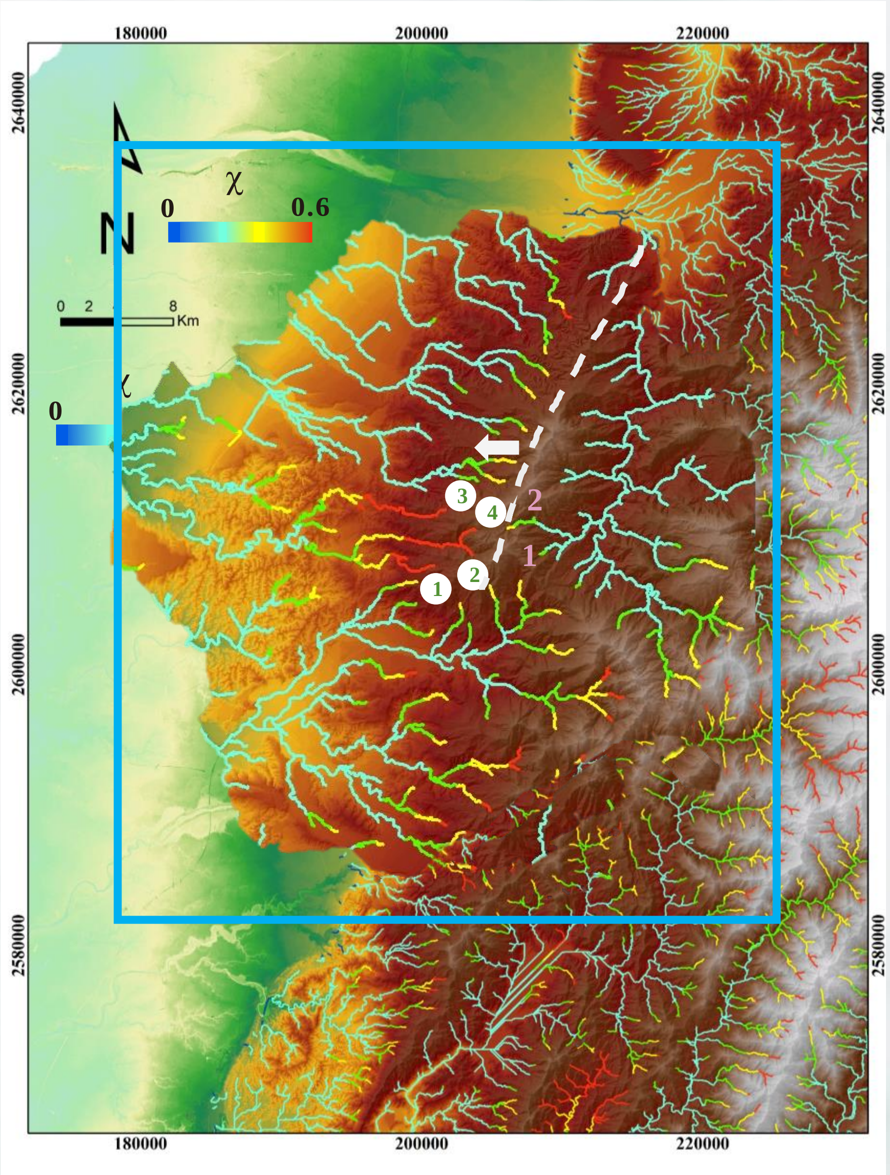
Sandie river



Qingshui river

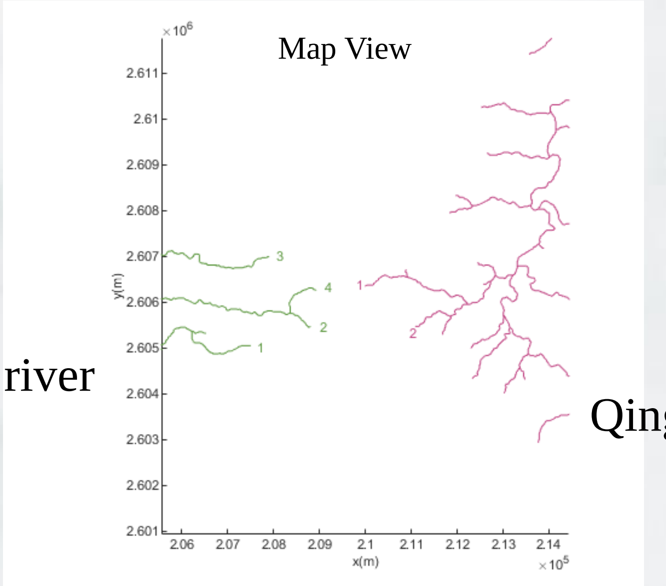


High Ksn indicates
1. Tectonic event
2. High capability of head erosion
3. Potential wind gap

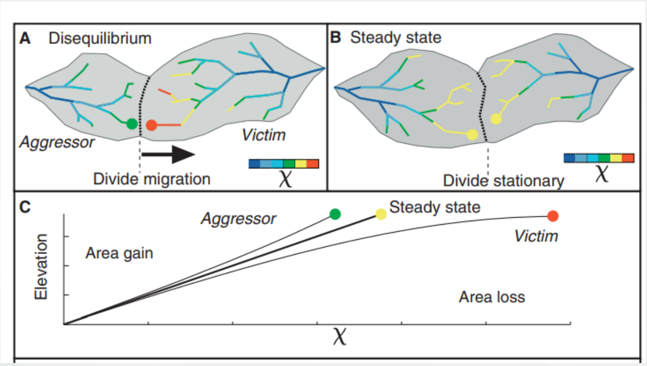


χ - Map_20m

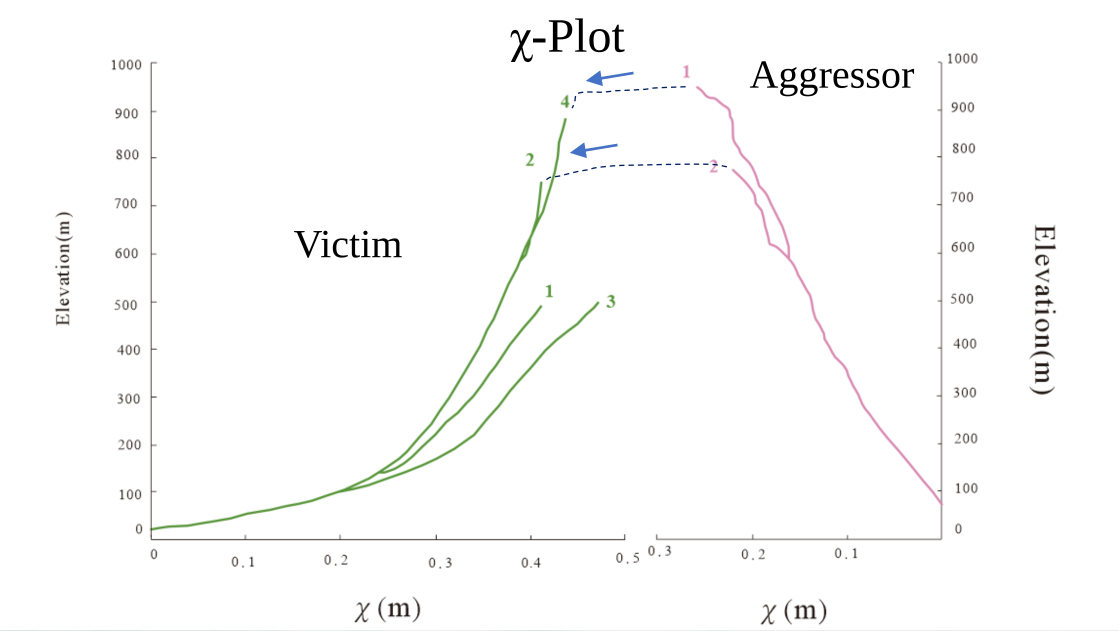
Sandie river

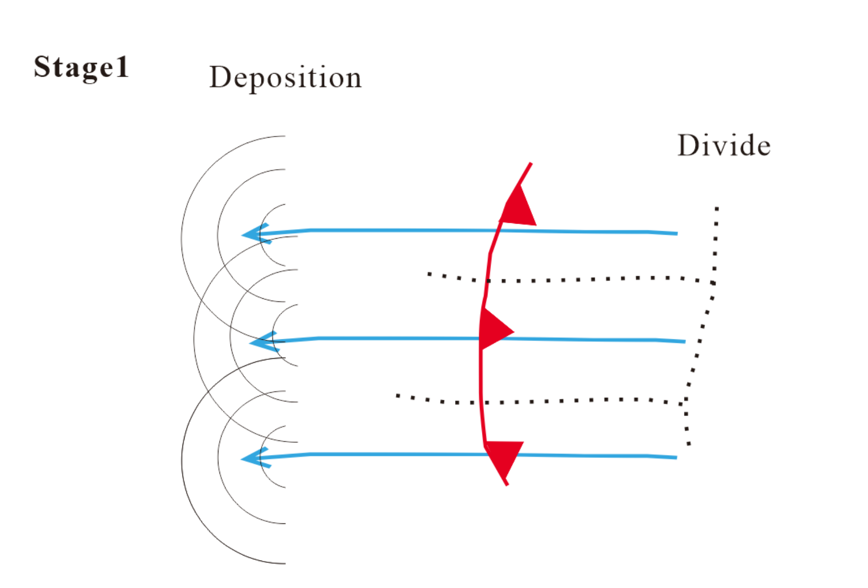


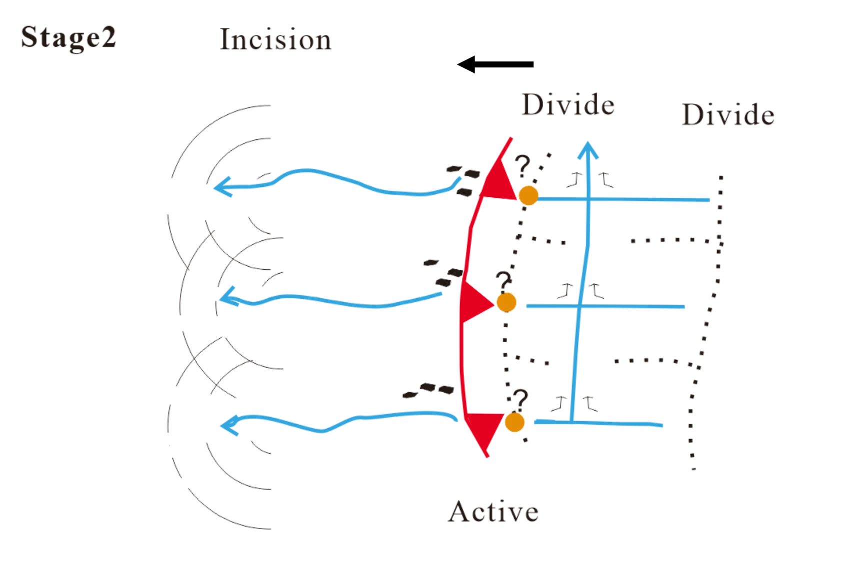
Qingshui river

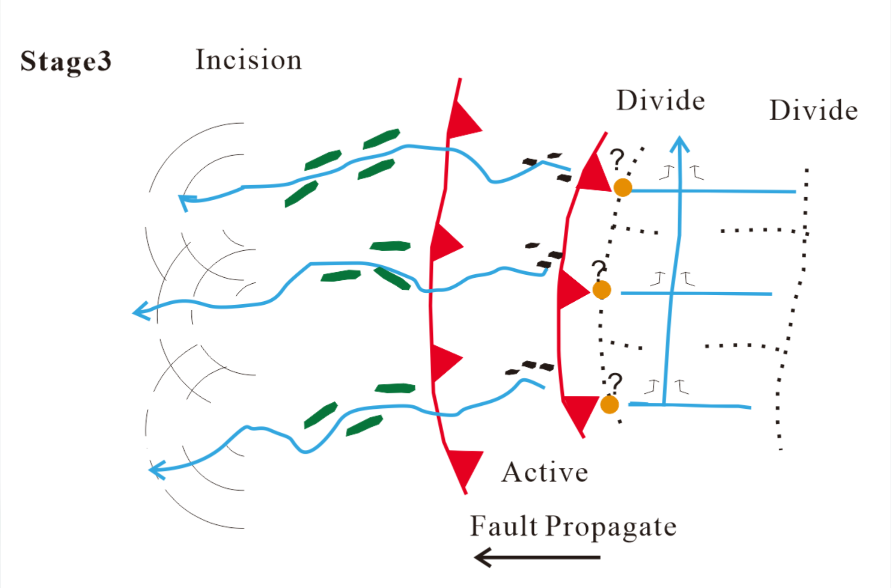


(Willett et at., 2014)

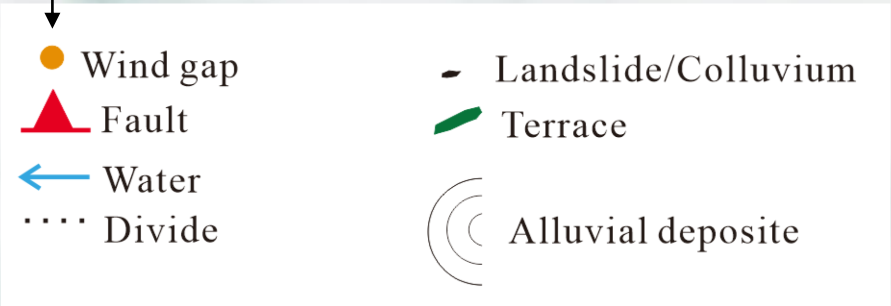








Taiping Suspension Bridge(太平雲梯)

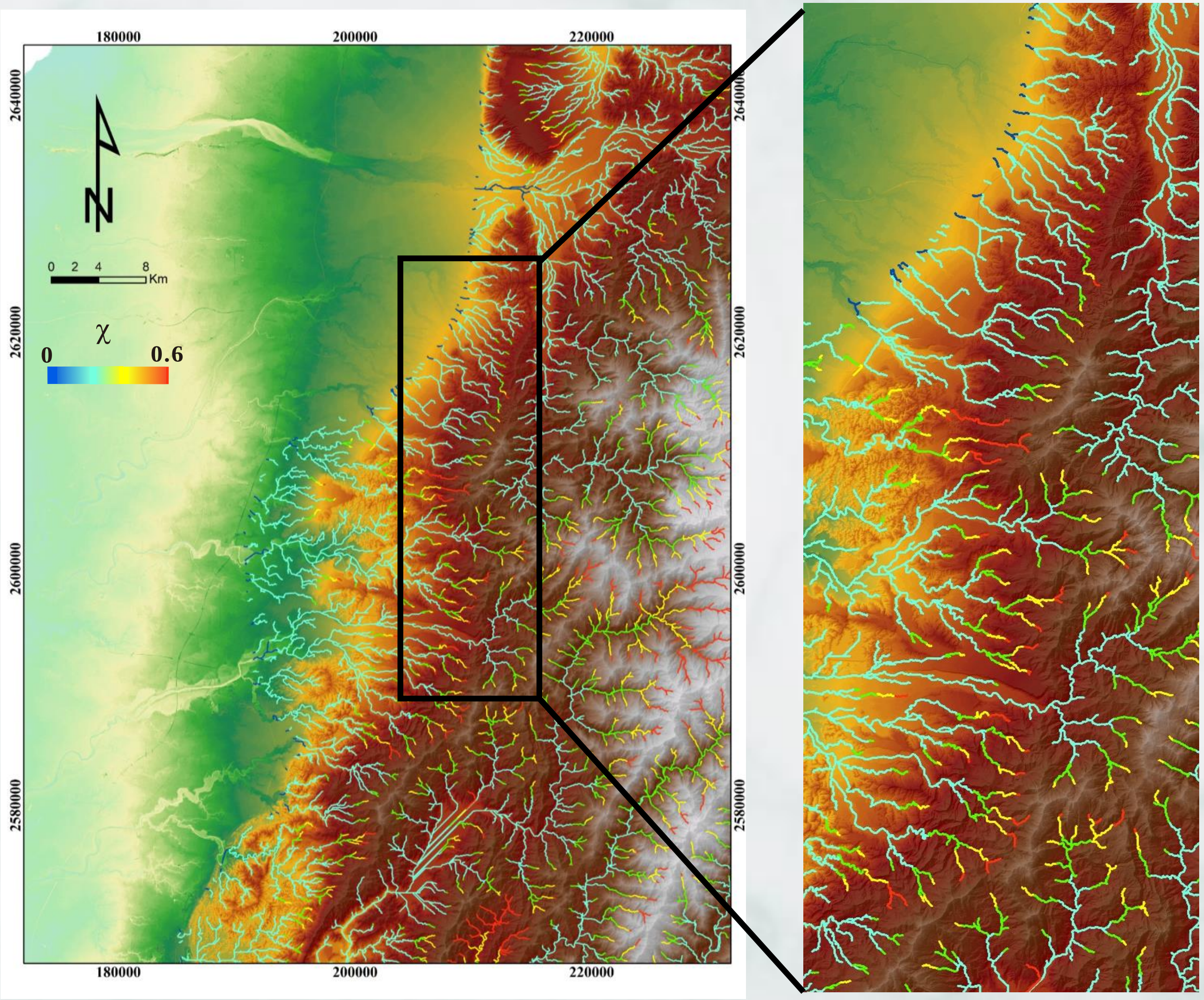


1. The Qingshui river(清水溪) is one possible source of the big fan, and Taiping Suspension Bridge is the potential wind gap, but it still need the evidence to prove.

2. The factors for the river path changing is probably due to fault activity.

3. We propose that the rivers in this area will tend to flow toward the west in the future.

1. To analyze χ and steepness for each catchment.



χ - Map_20m

2. To check the potential wind gap in the field.

3. Have time constraint
(collect the sample from terraces)

Thanks For Your Attention.